Competitive Evolution of Indian Power Sector

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***Abstract*—In an energy market, India is in the midst of restructuring. Electricity preparation is an integral part of the sustainable reform of electricity. The idea of restructuring and deregulation, which tends to be implemented according to each nation's individual needs, has become relatively new. In the current situation, for example, price-based unit engagement and optimum power flow strategies with bidding generations and charging characteristics are completely different from a controlled configuration. India is in the transformation of the power sector reform. Power planning is a vital factor and key to Indian economic development for sustainable power reform. A decline in maintenance and in new projects may be a significant potential result of deregulation. This paper highlights the Indian Government's new plans and policies for deregulation.**

Keywo*rds: Deregulated Power Sector, Models of Deregulation, Restructuring.*

I. Introduction

The worldwide power industry has undergone a rapid transition in the production, transmission and delivery systems over the last two decades. India is in the transformation of the power sector reform. Electricity preparation is an integral part of the sustainable reform of electricity. However, reform would alter the power planning significantly, in particular the planned expansion approach of power generation. The modernization and transformation of the power supply market is one of the world's most significant energy trends in the last century. In much of the 1980s, the financing, construction, owning and operating of the supply system depended on state monopolies. More than 30 nations and regions have been implementing measures to overhaul their energy generation markets since the mid-1990s [1-2].

India is in the transformation of the power sector reform. Electricity preparation is an integral part of the sustainable reform of electricity. However, reform would alter the power planning significantly, in particular the planned expansion approach of power generation. Deregulation promoted development of new independent power producers that changed the energy power plant industry in their market requirements. 'Deregulation' implies the cessation of the outline of the law. "Restructure" of the power system. Deregulation is a method of reforming energy market rules and regulations to enable consumers to choose electricity providers who are retail or traders to compete. It means starting to compete with the new industry leaders without price restraint. The regulations were not concluded but rather renovated the existing electricity sector system. The solution to reform of the power structure was fuelled by several causes. In the context of deregulation, the electricity utility is believed to be trying to make a little innovation in improving the repair and in order to put its costs to take advantage of the profit. Via this, the simplicity would aim to ensure that despite rivalry, the customers are maintained. Deregulation has provided electrical resources with a new factor in which commodities are measured. In a successful transformation of the electricity market, the advertising concept is a major liability.

II. Indian Power Sector Structure

The Indian electricity sector is undergoing a reform and consolidation progression. Under the reform, separate regulatory commissions are established in the Centre, as are state-friendly and vertically integrated companies. While the Indian power sector has increased its installed capacity 6 times over the last few years, from 30 GW in 1981 to over 384 GW [3] by 31 March 2021, the generation and demand divide in India is still enormous, so it is necessary to create more production plants that will better be generated from government and private participants from renewable sources. In the national energy strategy, national power planning and national regulatory matters, the duties of the Centre Electricity Authority (CEA) are to advise the Ministry of Public Energy while the State Electrical Regulatory Committees (SERCs) perform the same role at state level.

The regional total installed power in India (in terms of percentage) is shown in Figure 1 till 31 March 2021.

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Inter-regional power sharing has been increasingly varied through the creation of numerous inter-regional ties. In addition to achieving a general economy, the growth in interregional power trade has contributed to satisfying more demand in energy deficit regions [4].

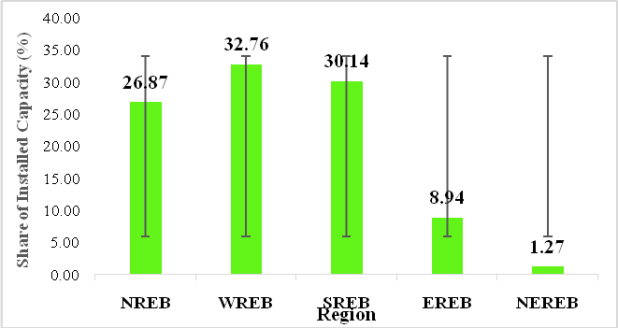

Fig. 1: Percentage of Region Wise Installed Capacity

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Table 1: Installed Capacity (MW) in India

S. No	Region	Total
1.	NREB	102689.05
2.	WREB	125181.40
3.	SREB	115164.97
4.	EREB	34176.90
5.	NEREB	4863.64
6.	Islands	75.27
All India		382151.22

The nation was currently split into two grids: the South Grid one and the other Eastern, Western and North Eastern one. Whilst India does not currently have a single national grid, it plans to develop into 'One Grid' by 2012. The single grid infrastructure would address the electricity problems of states with a power shortage by enhancing intra-regional power transmission, with renewable integration as well. CEA and SERC are expected to support renewable energy investments under the Electricity Law 2003, including appropriate grid connection initiatives, and specifying a percentage of the overall electricity usage of the area [5].

III. Restructuring of the Indian Power Sector

The role of generation, transmission and distribution in the power sector is independent in the new restructured power industry. Cheaper energy, effective capacity growth preparation, cost minimum, more option and improved operation are the major advantages gained by reforming power systems. Electricity reform has been driven through: technical advances, in particular the improvement of gas turbines' efficiency; increased investments in developed countries in particular, such as India; high electricity prices and the transition from the point of view of the natural monopoly in electricity supply.

With regard to the advantages and disadvantages of various restructuring cycles in various countries, it is easy to understand that India is not ready yet for restructuring. The first big challenge with transformation is the demand-generation divide. The restructuring method as a whole is a very dynamic and overlapping and interrelated processes have been proposed here. This report therefore proposes the following move for Indian energy restructuring [6]:

1. Bridging the gap between energy demand and production of electricity
2. Decentralize the process of designing generators for quick entry
3. Enhance transmission lines intra-state
4. Tariff increase gradually
5. Reduce direct oversight of government
6. Establish an independent regulatory body
7. Dismiss SEBs as generating, transmitting and distributing entities
8. Privatize and market power companies
9. Provide a market with sustainable strength

The Indian power sector has serious problems of consumers' failure to pay at all costs, rising fiscal losses for REBs, massive power thefts, over-powering, underinvestment in transmission and distribution, the power outages from poor transmission, and so on.

A. Electricity Act 2003

The bill seeks to broaden the reach of power sector reforms. This act consolidates the existing legislation and adds protections for future technologies in the industry. It focuses on fostering competition, defending customer rights, and rationalising tariffs, among other things [7-8]. The regulators are granted all requisite authority, including the ability to grant licences, and are seen as separate bodies from the government. Some of the major provisions of the Electricity Act are:

a. A national approval and clearance by the CEA are required for the purpose of hydro-projects in order to verify the safety aspects and the optimal use of water supplies.

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b. The transmission utility operated by the state will be located both central and state, which will be responsible for overseeing the scheduled and coordinated development of the transmission network to satisfy industry requirements. In either case the feature to monitor the load shipment may be merged into or removed from the transmission system.
c. This Act provides for private broadcasting licensees.
d. Open transport access with cross-subsidy additional charges, which will be phased out progressively.
e. Licensees of distribution are free to start producing and companies of generation are free to accept licensee of distribution.
f. Stand-alone generation and delivery systems will be allowed for rural and remote areas. This clause appears to encourage captive and distributed power plants (CPPs).
g. Decentralized distribution control by panchayats, cooperatives, etc. is allowed in rural areas. Regulatory commissions are allowed to issue power trading licences and to set the upper limit on power trading margins.

B. Availability Based Tariff (ABT)

Two big path-breaking laws have opened the door to Indian electricity sector reform, ABT and the Electrical Act 2003. ABT is concerned with the bulk power tariff mechanism and seeks, by an incentives and disincentives system, to increase the responsibility for and transparency of power generation and usage [9]. The notice states that ABT applies only to central grading stations which are recipients of more than a SEB/State/Union Territory. The Central Electricity Regulatory Commission (CERC) hopes that by implementing this system, it will be able to improve power efficiency while also limiting the following destructive developments in the electricity industry:

a. Unacceptable sudden and high frequency fluctuations (from 50 Hz), causing harm and delays to large-scale industrial consumers; and
b. Frequent grid irregularities, resulting in transformer tripping, power outages, and power grid disintegration.

C. Transmission and Distribution Reforms

On 10 August 1998, the Electricity Law Amendment Acts, 1998, was adopted. Within this Act, a special activity was carried out to encourage greater interest in public and private investment. The central government stressed that vertically organized SEBs must be unbundled and corporate. Although the distribution is a matter of the State, the central government has provided the governments of the State with all necessary assistance in improving the distribution system [10]. On December 18, 1998, a Chief Ministers'/Power Ministers' Conference was convened to address and deliberate on crucial issues relating to the power sector, and an action plan was adopted.

IV. Deregulated Power System Components

The following framework components reflect different divisions of the electricity sector. Any of these elements can be consolidated together or further unbundled, depending on the composition and regulatory context. Various federal, national, provincial, and independent generators coexist in some Asian countries. In these cases the financial and technical interrelationship are murky and are in a process of rapid evolution [11-12].

1. Generation companies (GENCOs): GENCOs is responsible for the operation and maintenance in the production sector of production plants and, in most cases, the plant owners. In certain cases, individual generators don't market their performance, only genco markets their generators' performance.
2. Build operate and transfer (BOT): farm or independent power generators (IPPs) BOTs or IPPs may operate as their own generator-serving entity, marketing their output separately to a trading entity or a load–serving entity.
3. Transmission companies (TRANCOs) and transmission owners (TOs): TRANSCOs transfers' electricity to where it is supplied in bulk volumes. Transmission undertakings are owners and maintainers of monopoly franchise transmission lines in most deregulated industrial systems, termed transmission owners (TOs). This is done by independent machine operators.
4. Distribution companies (DISCOs) and retailers: DISCOs assume on the delivery side the same burden as with a conventional regulatory provider. The trend in deregulation is, however, that Discos can now limit themselves to maintaining the distribution network and delivering electricity while retailers are segregated from Disco's and are selling electricity to end-users.
5. Independent system operator (ISO): The ISO controls the transmission system as the highest body. An ISO's basic condition is that all industry players are disassociated and there is no commercial stake in the company for generation and delivery.
6. Power exchanger (PX): The PX manages the energy tank, a forum that meets supply and demand of electricity on the basis of quotations. There can be a half hour or a week longer time frame on the pool market. The best practice will be the daily market, one day before each day of operation, to encourage energy trading..
7. Scheduling coordinators (SCs): SCs are members of the energy trade and protocols that vary from pool

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rules can be used free of charge. This means, by means of bilateral and multilateral transactions, participants in the market of a SC can join under the rules of the SC.

VIII. Information Flow in a Deregulated Power Sector

Historically, technical and business knowledge has been confined to each scheme, with no exchange with the other systems. However, deregulation resulted in a diverse range of information flow within systems in terms of type and quantity [13]. This data is primarily used to maintain the system's physical function, economic performance, and power quality. Figure 2 illustrates typical system and market operations in deregulated power sector. Device coordinators track grid inflows and outflows, as well as other conditions such as voltage profile, in the system to ensure system reliability [14]. To ensure system reliability and functionality, operating conditions must be assessed, distributed, stored, and tracked in real time, and the required measures must be dispatched. Real-time state details on grid activity may be used in the future to help business functions such as calculating the cost of bulk power purchases on the transmission system.

Adequate and easily available electric vehicle (EV) charging infrastructure is a prerequisite for EV mass adoption. To reach an electric mobility future, policymakers must concentrate on developing the requisite charging facilities – infrastructure that will accommodate the target vehicle numbers. Figure 3 provides the information regarding the number of EV charging stations existing in different states of India. Although there is no ideal EV to charging station ratio to strive for, each country would have to develop fit-for-purpose solutions to meet their electric mobility needs. The state and central government policies are adequate to create a conducive EV charging network in India.

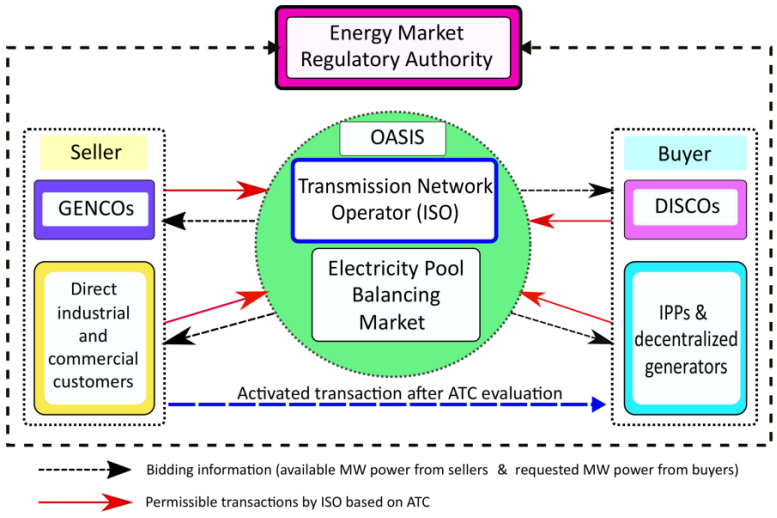

Fig. 2: Deregulated Control, Information and Resources Transfer.

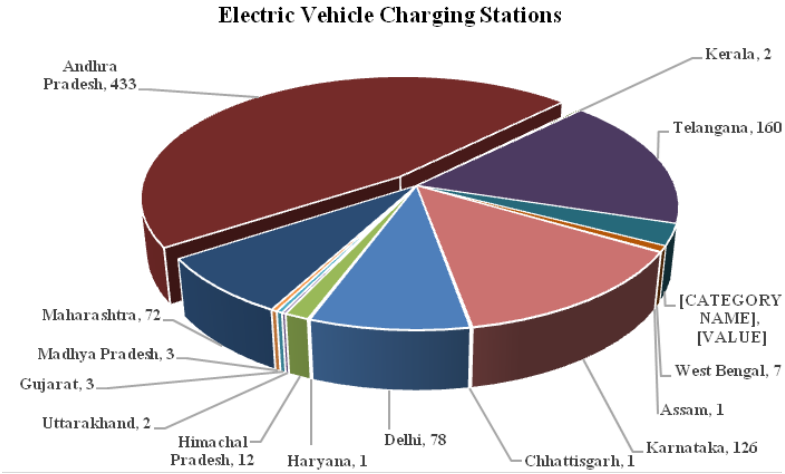

Fig. 3: Electric Vehicle Charging Stations in India

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V. Conclusions

The global demand for energy has increased as a consequence of industrialization and population growth. In addition, Global environmental challenges along with steady developments in technology for solar energy allow new ways to use renewable energy tools. Various methods like the use of sunshine to produce power directly or heat from the sun as a thermal energy may be used. India's power supply shortage is an important obstacle to smooth economic growth. The deregulation of the electricity sector, the advent of renewable technology and an increase in disasters are increasingly impacting the sustainability of electricity networks. The deregulation mechanism focuses on improvement of system quality, improvement of service levels and competitive market development. Power restructuring strategy approach is really relevant. The process of electricity reform is still underway in India, but slowly. Various state electricity broadcasting companies are separated into three separate companies: generation, transmission and distribution.

References

[01] A.Banshwar, N. K. Sharma, Y. R.Sood, R. Shrivastava, Market based procurement ofenergy and ancillary services from renewable energy sources in deregulated environment.Renew Energy 2017; 101:1390–400.

[02] J. E. Besant-Jones, B. Tenenbaum, 2001. Lessons from California's power crisis. Finance and Development 38(3), 24–28.

[03] Ministry of Power. Available: http://www.powermin.nic.in [online].

[04] A. Srivastava, M. Shahidehpour"Restructuring choices for the Indian Power sector" IEEE Power Engineering Review, pp. 25- 29,November 2002,

[05] The Electricity Act, 2003, Section 3.1 and 86.1.

[06] A. Srivastava, M. Shahidehpour, "Restructuring Choices for the Indian Power Sector", IEEE Power Engineering Review, pp. 25-29, 2002.

[07] A.Banshwar, N. K. Sharma, Y. R.Sood, R. Shrivastava, Renewable energy sources as anew participant in ancillary service markets. Energy Strategy Review2017; 18:106–120.

[08] A. Banshwar, N.K. Sharma, Y.R. Sood and R. Shrivastava,A Sequential Optimization Approach for CompetitiveProcurement of Energy and Ancillary Services, IEEEInternational Conference on Electrical Power and EnergySystems, 498–503, 2016.

[09] Lai Loi Lai, "Power System Restructuring and Deregulation, (book), Publisher: John Wiley and Sons, Ltd., New York, 2001.

[10] M.A. Fischetti "Electric Utilities: Poised for Deregulation", IEEE Spectrum, May 1986, pp.34-43

[11] A. J. Wood and B. F. Wollenberg, "Power Generation, Operation and Control, John Wiley and Sons, New York, 1996.

[12] M. Doll and J. F. Verstege, "Congestion Management in a Deregulated Environment Using Corrective Measures", In: Proceedings of the IEEE- 2001, pp. 393-398.

[13] S. S. Vindal, N. S. Saxena, and S. C. Srivastava, "Industry Structure under Deregulated Wholesale Power Markets in India", Proceedings of International Conference on Present and Future Trends in Transmission and Convergence, New Delhi, India, December 2002.

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